

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions and listings of claims in the application:

1. (Currently Amended) An optical pickup apparatus, comprising:
 - a first light source for emitting a first light flux having a first wavelength for reproducing or recording information from or onto a first optical information recording medium having a first transparent substrate and a first information recording plane, the first transparent substrate having a first thickness;
 - a second light source for emitting second light flux having a second wavelength for reproducing or recording information from or onto a second optical information recording medium having a second transparent substrate and a second information recording plane, the second transparent substrate having a second thickness, the first wavelength being different from the second wavelength, and the first thickness being different from the second thickness;
 - a converging optical system comprising having an optical axis, a first diffractive portion, and a second diffractive portion farther from the an optical axis of the converging optical system than first diffractive portion;
 - a photo detector for receiving light flux reflected from the first information recording plane or the second information recording plane;
 - wherein in case that the first light flux passes through the first diffractive portion to generate at least one diffracted ray, an amount of first n-th ordered diffracted ray of the first light flux is great greater than that of any other ordered diffracted ray of the first light flux, and in case that the second light flux passes through the first diffractive portion

to generate at least one diffracted ray, an amount of the second n-th ordered diffracted ray of the second light flux is great greater than that of any other ordered diffracted ray of the second light flux, where n stands for one integer other than zero, and where the n of the first n-th ordered diffracted ray is equal to the n of the second n-th ordered diffracted ray;

wherein the converging optical system converges the first n-th ordered diffracted ray of the first light flux which passes through the first diffractive portion and a diffracted ray of the first light flux which passes through the second diffractive portion on the first information recording plane of the first optical information recording medium through the first transparent substrate so as to reproduce or record information from or onto the first optical information recording medium; and

wherein the converging optical system converges the second n-th ordered diffracted ray of the second light flux which passes through the first diffractive portion on the second information recording plane of the second optical information recording medium through the second transparent substrate so as to reproduce or record information from or onto the second optical information recording medium.

2-6. (Cancelled).

7. (Previously Presented) The optical pickup apparatus of claim 1, wherein the following formula is satisfied:

$$\lambda_1 < \lambda_2 \text{ and } t_1 < t_2$$

wherein λ_1 is the wave length of the first light flux,

λ_2 is the wave length of the second light flux,
 t_1 is the thickness of the first transparent substrate, and
 t_2 is the thickness of the second transparent substrate.

8. (Currently Amended) The optical pickup apparatus of claim 7, wherein the converging optical system comprises an objective lens and the following formula is satisfied:

$$\underline{NA_1 > NA_2}$$

wherein NA_1 is a predetermined numerical aperture of the first optical information recording medium for the first light flux at an image side of the objective lens, and NA_2 is a predetermined numerical aperture of the second optical information recording medium for the second light flux at an image side of the objective lens.

9. (Previously Presented) The optical pickup apparatus of claim 8, wherein n is +1.

10. (Original) The optical pickup apparatus of claim 8, wherein the following formula is satisfied:

$$0.55 \text{ mm} < t_1 < 0.65 \text{ mm}$$

$$1.1 \text{ mm} < t_2 < 1.3 \text{ mm}$$

$$630 \text{ nm} < \lambda_1 < 670 \text{ nm}$$

$$760 \text{ nm} < \lambda_2 < 820 \text{ nm}$$

$$0.55 < NA_1 < 0.68$$

$0.40 < NA2 < 0.55$

11-12. (Cancelled).

13. (Original) The optical pickup apparatus of claim 10, wherein t1 is 0.6 mm, t2 is 1.2 mm, λ_1 is 650 nm, λ_2 is 780 nm, NA1 is 0.6 and NA2 is 0.45.

14. (Currently Amended) The optical pickup apparatus of claim 8, wherein the converging optical system comprises an objective lens, and the objective lens ~~has-a~~ comprises the first diffractive portion and ~~a~~ the second diffractive portion, and wherein in case that the converging optical system converges the second n-th ordered diffracted ray of the second light flux which passes through the first diffractive portion on the second information recording plane of the second optical information recording medium, a spherical aberration comprises a discontinuing section in at least one place.

15. (Original) The optical pickup apparatus of claim 14, wherein the spherical aberration comprises the discontinuing section at a place near NA2.

16-18. (Cancelled).

19. (Currently Amended) The optical pickup apparatus of claim 8, wherein the converging optical system comprises an objective lens, the objective lens ~~has-a~~ comprises the first diffractive portion and the second diffractive portion, and wherein in

case that the converging optical system converges the second n-th ordered diffracted ray of the second light flux ~~having passed over which passes through the first~~ diffractive portion on the second information recording plane of the second optical information recording medium in order to conduct the recording or the reproducing for the second optical information recording medium, a spherical aberration is continued without having a discontinuing section.

20-24. (Cancelled).

25. (Original) The optical pickup apparatus of claim 1, wherein a difference in wavelength between the first light flux and the second light flux is 80 nm to 400 nm.

26. (Previously Presented) The optical pickup apparatus of claim 1, wherein the first diffractive portion and the second diffractive portion comprise a plurality of annular bands formed coaxially around the optical axis or centered around a point near the optical axis.

27-49. (Cancelled).

50. (Previously Presented) The optical pickup apparatus of claim 1, wherein n is +1 or -1.

51-61. (Cancelled).

62. (Original) The optical pickup apparatus of claim 1, wherein the converging optical system comprises a objective lens, and wherein the first light flux of non-parallel light flux is allowed to go into the objective lens when the first light flux is used, and the second light flux of non-parallel light flux is allowed to go into the objective lens when the second light flux is used.

63-64. (Cancelled).

65. (Original) The optical pickup apparatus of claim 1, wherein the converging optical system comprises a objective lens, and wherein the first light flux of parallel light flux is allowed to go into the objective lens when the first light flux is used and the second light flux of non-parallel light flux is allowed to go into the objective lens when the second light flux is used, or the first light flux of non-parallel light flux is allowed to go into the objective lens when the first light flux is used and the second light flux of parallel light flux is allowed to go into the objective lens when the second light flux is used.

66-67. (Cancelled).

68. (Previously Presented) The optical pickup apparatus of claim 1, wherein the converging optical system comprises an objective lens, and wherein the first light flux of parallel light flux is allowed to go into the objective lens when the first light flux is

used and the second light flux of parallel light flux is allowed to go into the objective lens when the second light flux is used.

69-75. (Cancelled).

76. (Original) The optical pickup apparatus of claim 1, wherein over shoot is 0% to 20%.

77. (Currently Amended) An objective lens for use in an optical pickup apparatus for reproducing or recording information from or onto an optical information recording medium, the objective lens comprising:

an optical axis; and

a first diffractive portion and a second diffractive portion farther from the optical axis than the first diffractive portion,

wherein in case that a first light flux having a first wavelength for reproducing or recording information from or onto a first optical information recording medium having a first transparent substrate passes through the first diffractive portion to generate at least one diffractive ray, an amount of first n-th ordered diffracted ray of the first light flux is greater than that of any other ordered diffracted ray of the first light flux, and in case that a second light flux having a second wavelength for reproducing or recording information from or onto a second optical information recording medium having a second transparent substrate passes through the diffractive portion to generate at least one diffracted ray, an amount of second n-th ordered diffracted ray of the second light flux is

greater than that of any other ordered diffracted ray of the second light flux, the first wavelength being different from the second wavelength, a difference in wavelength between the first light flux and the second light flux being 80 nm to 400 nm, and the thickness of the first transparent substrate being different from the thickness of the second transparent substrate, where n stands for one integer other than zero, and where the n of the first n-th ordered diffracted ray is equal to the n of the second n-th ordered diffracted ray, so that the objective lens converges the first n-th ordered diffracted ray of the first light flux which passes through the first diffractive portion and a diffracted ray of the first light flux which passes through the second diffractive portion on a first information recording plane of the first optical information recording medium through the first transparent substrate so as to reproduce or record information from or onto the first optical information recording medium, and the objective lens converges the second n-th ordered diffracted ray of the second light flux which passes through the first diffractive portion on a second information recording plane of the second optical information recording medium through the second transparent substrate so as to reproduce or recording information from or onto the second optical information recording medium.

78-83. (Cancelled).

84. (Previously Presented) The objective lens of claim 77, wherein the following formula is satisfied:

$$\lambda_1 < \lambda_2 \text{ and } t_1 < t_2$$

where λ_1 is the wave length of the first light flux,

λ_2 is the wave length of the second light flux,

t_1 is the thickness of the first transparent substrate, and

t_2 is the thickness of the second transparent substrate.

85. (Currently Amended) The objective lens of claim 84, wherein the following formula is satisfied:

$$NA_1 > NA_2$$

wherein NA_1 is a predetermined numerical aperture of the first optical information recording medium for the first light flux at an image side of the objective lens, and NA_2 is a predetermined numerical aperture of the second optical information recording medium for the second light flux at an image side of the objective lens.

86. (Previously Presented) The objective lens of claim 85, wherein n is +1.

87. (Previously Presented) The objective lens of claim 85, wherein the following formula is satisfied:

$$0.55 \text{ mm} < t_1 < 0.65 \text{ mm}$$

$$1.1 \text{ mm} < t_2 < 1.3 \text{ mm}$$

$$630 \text{ nm} < \lambda_1 < 670 \text{ nm}$$

$$760 \text{ NM} < \lambda_2 < 820 \text{ nm}$$

$$0.55 < NA_1 < 0.68$$

$$0.40 < NA_2 < 0.55.$$

88-89. (Cancelled).

90. (Previously Presented) The objective lens of claim 87, wherein t1 is 0.6 mm, t2 is 1.2 mm, λ_1 is 650 nm, λ_2 is 780 nm, NA1 is 0.6 and NA2 is 0.45.

91. (Currently Amended) The objective lens of claim 85, wherein ~~the optical element is an objective lens, and in case that the objective lens converges the second n-th ordered diffracted ray of the second light flux, which passes through the first diffractive portion on the second information recording plane of the second optical information recording medium, a spherical aberration comprises a discontinuing section in at least one place.~~

92. (Previously Presented) The objective lens of claim 91, wherein the spherical aberration comprises the discontinuing section at a place near NA2.

93-95. (Cancelled).

96. (Currently Amended) The objective lens of claim 85, wherein in case that the objective lens converges the second n-th ordered diffracted ray of the second light flux, which passes through having passed over the first diffractive portion on the second information recording plane of the second optical information recording medium in order to conduct the recording or the reproducing for the second optical information recording

medium, ~~the~~ a spherical aberration is continued without having a discontinuing section.

97-101. (Cancelled).

102. (Previously Presented) The objective lens of claim 77, wherein the first diffractive portion and the second diffractive portion comprise a plurality of annular bands formed coaxially around the optical axis or around a center point near the optical axis.

103-112. (Cancelled).

113. (Previously Presented) The objective lens of claim 102, wherein the first diffractive portion and the second diffractive portion are provided on substantially the entire light flux-incoming surface or substantially the entire light flux-outgoing surface of the objective lens.

114. (Previously Presented) The objective lens of claim 102, wherein the first diffractive portion and the second diffractive portion are provided on a part of a light flux-incoming surface or a light flux-outgoing surface of the objective lens.

115-127. (Cancelled).

128. (Previously Presented) The objective lens of claim 77, wherein n is +1 or -

1.

129-133. (Cancelled).

134. (Original) The optical pickup apparatus of claim 77, wherein over shoot is 0% to 20%.

135. (Currently Amended) An apparatus for reproducing or recording information from or onto an optical information recording medium, the apparatus comprising;

an optical pickup apparatus, comprising

a first light source for emitting a first light flux having a first wavelength for reproducing or recording information from or onto a first optical information recording medium having a first transparent substrate and a first information recording plane, the first transparent substrate having a first thickness;

a second light source for emitting second light flux having a second wavelength for reproducing or recording information from or onto a second optical information recording medium having a second transparent substrate and a second information recording plane, the second transparent substrate having a second thickness, the first wavelength being different from the second wavelength, and the first thickness being different from the second thickness;

a converging optical system comprising having an optical axis, a first diffractive portion, and a second diffractive portion farther from the an optical axis of the converging optical system than the first diffractive portion; and

a photo detector for receiving light flux reflected from the first information recording plane or the second information recording plane;

wherein in case that the first light flux passes through the first diffractive portion to generate at least one diffracted ray, an amount of first n-th ordered diffracted ray of the first light flux is greater than that of any other ordered diffracted ray of the first light flux, and in case that the second light flux passes through the first diffractive portion to generate at least one diffracted ray, an amount of second n-th ordered diffracted ray of the second light flux is greater than that of any other ordered diffracted ray of the second light flux, where n stands for one integer other than zero, and where the n of the first n-th ordered diffracted ray is equal to the n of the second n-th ordered diffracted ray;

wherein the converging optical system converges the first n-th ordered diffracted ray of the first light flux which passes through the first diffractive portion and a diffracted ray of the first light flux which passes through the second diffractive portion on the first information recording plane of the first optical information recording medium through the first transparent substrate so as to reproduce or record information from or onto the first optical information recording medium, and

wherein the converging optical system converges the second n-th ordered diffracted ray of the second light flux which passes through the first diffractive portion on the second information recording plane of the second optical information recording

medium through the second transparent substrate so as to reproduce or record information from or onto the second optical information recording medium.

136. (Currently Amended) A method of reproducing information for or recording information on at least two kinds of optical information recording media by an optical pickup apparatus comprising a first light source, a second light source, a photo detector and a converging optical system having an optical axis, a first diffractive portion and a second diffractive portion located farther from the optical axis more than the first diffractive portion, the method comprising the steps of:

emitting a first light flux from the first light source or a second light flux from the second light flux, wherein a wavelength of the second light flux is different from a wavelength of the first light flux;

letting the first light or the second light flux pass through the first diffractive portion to generate at least one diffractive ray of the first light flux or a least one diffracted ray of the second light flux, wherein when an amount of first n-th ordered diffracted ray among the at least one diffracted ray of the first light flux is greater than an amount of any other ordered diffracted ray of the first light flux, an amount of second n-th ordered diffracted ray among the at least one diffracted ray of the second light flux is greater than an amount of any other ordered diffracted ray of the second light flux; and

converging, by the converging optical system, the first n-th ordered diffracted ray of the first light flux which passes through the first diffractive portion and a diffracted ray of the first light flux which passes through the second diffractive portion onto a first information recording plane of a first optical information recording medium through the

first transparent substrate so as to reproduce or record information from or onto the first optical information recording medium, or converging, by the converging optical system, the second n-th ordered diffracted ray of the second light flux which passes through the first diffractive portion onto a second information recording plane of a second optical information recording medium through the second transparent substrate so as to reproduce or record information from or onto the second optical information recording medium, the thickness of the first transparent substrate being different from the thickness of the second transparent substrate; and

detecting, by a photo detector, a first reflected light flux of the converged n-th ordered diffracted light from the first information recording plane or a second reflected light flux of the converged n-th ordered diffracted light from the second information recording plane,

wherein n stands for one ~~an~~ integer other than zero and the n of the first n-th ordered diffracted ray is equal to the n of the second n-th ordered diffracted ray.

137. (New) The optical pickup apparatus of claim 19, wherein the spherical aberration at NA 1 is not smaller than 20 μm .

138. (New) The optical pickup apparatus of claim 137, wherein the spherical aberration at NA 1 is not smaller than 50 μm and the spherical aberration at NA 2 is not larger than 2 μm .

139. (New) The objective lens of claim 96, wherein the spherical aberration at NA 1 is not smaller than 20 μm and the spherical aberration at NA2 is not larger than 10 μm .

140. (New) The objective lens of 97, wherein the spherical aberration at NA1 is not smaller than 50 μm and the spherical aberration at NA 2 is not larger than 2 μm .